

**REMARKS**

Claims 1-20 are pending in this application. No amendment is made in this Response. It is believed that this Response is fully responsive to the Office Action dated March 24, 2009.

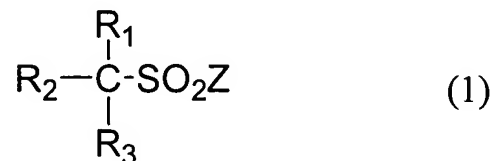
**Claims 1-20 are rejected under 35 U.S.C. §103(a) as being unpatentable over Drivon et al., (US 5,057,633) or Drivon et al., (US 4,912,269) in view of Storzer et al., (Two fluorinated, fluorosulfonyl-containing hypochlorites and their alkali-metal precursors, Inorganic Chemistry (1991), 30(25), 4821-4826). (Office action pages 2-3)**

The rejection of claims 1-20 is respectfully traversed, and reconsideration of the rejection is requested.

The independent claims of the present application are Claims 1, 6, 11, and 16. The non-obviousness of each of these independent claims is discussed below.

**(i) Claim 1:**

Claim 1 relates to a method for producing a fluorine-containing halide, comprising reacting a fluorine-containing sulfonyl halide with a metal halide in the presence or absence of a solvent, the fluorine-containing sulfonyl halide being represented by general formula (1):

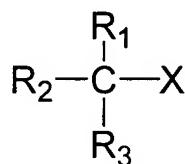


wherein R<sup>1</sup>, R<sup>2</sup> and R<sup>3</sup> are the same or different, each representing a halogen atom, a hydrogen atom or a monovalent hydrocarbon group which may contain one or more atoms of one or more kinds selected from fluorine, oxygen, nitrogen and sulfur atoms; at least one of R<sup>1</sup>, R<sup>2</sup> and R<sup>3</sup> is a halogen

atom; Z is Cl or F; provided that when none of  $R^1$ ,  $R^2$  and  $R^3$  is a fluorine atom, at least one of  $R^1$ ,  $R^2$  and  $R^3$  is a monovalent fluorine-containing hydrocarbon group, and when Z is F,  $R_1$  and  $R_3$  are both fluorine atoms and  $R_2$  is a  $CF_2=CFOCF_2$ - group;

the metal halide being represented by general formula  $M^1X$ , wherein  $M^1$  is Ma or  $(Mb)_{1/2}$ , Ma being an alkali metal, Mb being an alkaline earth metal, and X being Br or I;

the fluorine-containing halide being represented by the general formula shown below:



This method produces a fluorine-containing halide by reacting the fluorine-containing sulfonyl halide of general formula (1), which is used as a starting material, with the metal halide represented by general formula  $M^1X$ . According to this method, the terminal  $-SO_2Z$  of the compound of general formula (1) is replaced by  $-X$  via the reaction with  $M^1X$ , thereby producing the fluorine-containing halide represented by the general formula shown above.

By comparison, the newly cited references Drivon et al. (US 5,057,633) and Drivon et al. (US 4,912,269) disclose a method for the synthesis of a fluorine-containing bromide represented by general formula  $R_nBr$ , wherein a sulfonyl chloride represented by general formula  $R_nSO_2Cl$  is reacted with HBr.

Drivon et al. (US 5,057,633) also teaches a method for the synthesis of a fluorine-containing bromide represented by  $R_nBr$ , wherein  $R_nSO_2Cl$  is reacted with a quaternary (ammonium or phosphonium) bromide.

Therefore, the methods disclosed in the Drivon et al. references are related to the present invention in that a fluorine-containing bromide is produced from a sulfonyl chloride.

However, in the methods of the Drivon et al. references, the material to be reacted with the sulfonyl chloride is HBr or a quaternary (ammonium or phosphonium) bromide; whereas in the present Claim 1, the material to be reacted with the sulfonyl halide of general formula (1) is an alkali metal or alkaline earth metal bromide or iodide represented by general formula  $M^1X$ . Accordingly, the method of the invention clearly **differs** from the methods of Drivon et al.

Applicant further notes that among the reactants disclosed in Drivon et al. (US 5,057,633) and Drivon et al. (US 4,912,269), HBr is a corrosive gas, which has the disadvantage of being an expensive reagent and very difficult to handle. Quaternary (ammonium or phosphonium) bromides are also expensive reagents, and need to be handled or stored carefully since they are unstable compounds.

In contrast, in accordance with the method of the invention, the fluorine-containing halide represented by the general formula above can be obtained at a high yield, using the alkali metal or alkaline earth metal bromide or iodide, which is an inexpensive and widely used reagent.

In Drivon et al. (US 5,057,633) and Drivon et al. (US 4,912,269), which merely disclose HBr and a quaternary (ammonium or phosphonium) bromide, which are expensive and difficult to handle, as materials to be reacted with the sulfonyl chloride, there is no suggestion that the target fluorine-containing halide can be obtained at low cost and at a high yield by using the alkali metal or alkaline earth metal bromide or iodide represented by general formula  $M^1X$ .

With regard to this, the Examiner relies on "Storzer et al. (Two fluorinated fluorosulfonyl-containing hypochlorites and their alkali-metal precursor, *Inorganic Chemistry* (1991), 30 (25),

4821-4826)” for teaching a method for producing a fluorine-containing halide in the presence of a metal salt (KF).

The Examiner is of the opinion that, based on the combination of these references, a person skilled in the art would easily expect that the target fluorine-containing halide can be produced by evaluating a combination of the fluorine-containing sulfonyl halide with any commercially available metal halide.

Applicant submits, however, that the target product of Drivon et al. is a perfluoroalkyl bromide, whereas the target product of Storzer et al. is a perfluoroalkyl acid fluoride. Hence, these references **clearly differ in terms of the target product**. Further, they **clearly differ in terms of the starting materials as well**, since Storzer et al. uses a sulfonyl fluoride starting material, whereas Drivon et al. uses a sulfonyl chloride starting material.

As explained above, Drivon et al. and Storzer et al. differ in terms of both starting materials and target product, and hence, there is no motivation to consider a combination of the disclosures of these references.

Further, in the method of Storzer et al., the reactant to be reacted with the sulfonyl fluoride is KF, which is an alkali metal fluoride, whereas the method of the present Claim 1 requires the use of not a fluoride but **an alkali metal or alkaline earth metal bromide or iodide represented by general formula  $M^1X$**  as a reactant. The use of such a bromide or iodide as a reactant causes the reaction to remove  $SO_2$  from the fluorine-containing sulfonyl halide represented by general formula (1), enabling the target fluorine-containing halide to be produced at a high yield.

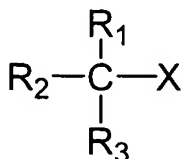
In contrast, the reaction of a compound represented by general formula (1) with an alkali metal fluoride barely causes the reaction to remove  $SO_2$ , and **instead causes the fluorination of the**

**sulfonyl halide group of the compound of general formula (1), producing a sulfonyl fluoride as the main product.**

For example, in Example 1 of the present specification, the reaction of the compound represented by the formula  $\text{CF}_2=\text{CFOCF}_2\text{CF}_2\text{SO}_2\text{Cl}$  with NaI produces  $\text{CF}_2=\text{CFOCF}_2\text{CF}_2\text{I}$  at an extremely high yield, namely with 100% conversion and a selectivity of 99% or more. In Example 2, the reaction of the compound represented by the formula  $\text{CF}_2=\text{CFOCF}_2\text{CF}_2\text{SO}_2\text{Cl}$  with NaBr produces  $\text{CF}_2=\text{CFOCF}_2\text{CF}_2\text{Br}$ , with 88.2% conversion and a selectivity of 99% or more.

Applicant further supports this argument with the evidence in the attached Declaration under 37 CFR 1.132 by Akinari SUGIYAMA. As is evident from the data in this Declaration, when the same starting material as mentioned above was reacted with NaF, which is an alkali metal fluoride, instead of a bromide or an iodide, the yield of the fluoride represented by the formula  $\text{CF}_2=\text{CFOCF}_2\text{CF}_2\text{SO}_2\text{F}$  was 51.4%, the main by-products produced were cyclic compounds, and the compound represented by the formula  $\text{CF}_2=\text{CFOCF}_2\text{CF}_2\text{F}$  was not detected.

As described above, Storzer et al. merely teaches a method for reacting a perfluoroalkyl acid fluoride with KF, which is an alkali metal fluoride. It would not be expected from the combination of the Drivon et al. references and Storzer et al., that when the fluorine-containing sulfonyl halide represented by general formula (1) is reacted with an alkali metal or alkaline earth metal bromide or iodide instead of an alkali metal fluoride, it is possible to produce the fluorine-containing halide represented by the general formula:

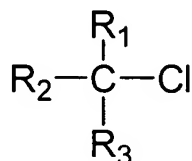


at a very high yield.

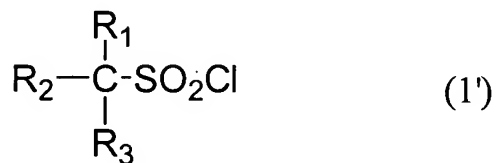
Accordingly, claim 1, as well as dependent claims 2-5, are not obvious over the Drivon et al. references and Storzer et al., taken separately or in combination.

(ii) Claim 6:

Claim 6 relates to a method for producing a fluorine-containing chloride represented by the general formula:



the method comprising reacting a fluorine-containing sulfonyl chloride with at least one member selected from the group consisting of metals belonging to periods 4 to 7 of groups 3 to 16 in the periodic table and compounds containing any of such metals, in the presence or absence of a solvent, the fluorine-containing sulfonyl chloride represented by general formula (1'):



This method completely differs from the methods of Drivon et al. and Storzer et al. in the use of “at least one member selected from the group consisting of metals belonging to periods 4 to 7 of groups 3 to 16 in the periodic table and compounds containing any of such metals” as the material to be reacted with the fluorine-containing sulfonyl chloride. As is evident from Example 4 of the

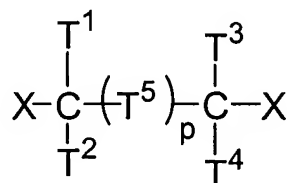
present specification, when this reactant is used,  $\text{CF}_2=\text{CFOCF}_2\text{CF}_2\text{Cl}$  is produced with 100% conversion and a selectivity of 99% or more.

It would not be expected from the combination of Drivon et al. and Storzer et al. that when this specific reactant is used, it is possible to produce the target fluorine-containing halide at a very high yield.

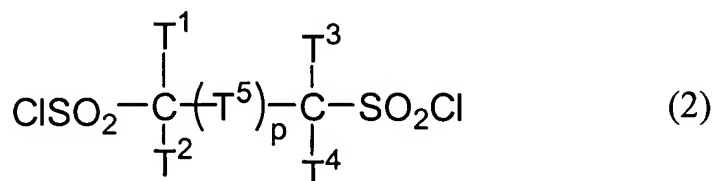
Accordingly, claim 6, as well as dependent claims 7-10, are not obvious over the Drivon et al. references and Storzer et al., taken separately or in combination.

(iii) Claims 11 and 16:

Claim 11 relates to a method for producing a fluorine-containing halide represented by the general formula:



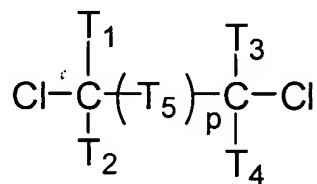
the method comprising reacting a fluorine-containing disulfonyl chloride with a metal halide in the presence or absence of a solvent, the fluorine-containing disulfonyl chloride represented by general formula (2):



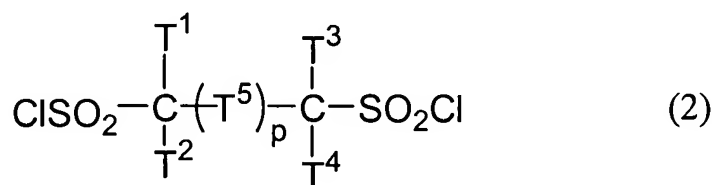
and the metal halide represented by the general formula  $\text{M}^1\text{X}$ , wherein  $\text{M}^1$  is Ma or  $(\text{Mb})_{1/2}$ , Ma being an alkaline metal, Mb being an alkaline earth metal, and X being Br or I.

This method, which uses a fluorine-containing disulfonyl chloride as the starting material, utilizes the same reaction as that of Claim 1 in that the material to be reacted with the starting material is a metal bromide or a metal iodide represented by the general formula  $M^1X$ , wherein X is Br or I, and the product is a fluorine-containing halide wherein the Xs (Br or I) are directly attached to the carbon atoms.

Claim 16 relates to a method for producing a fluorine-containing chloride represented by the general formula:



the method comprising reacting a fluorine-containing disulfonyl chloride with at least one member selected from the group consisting of metals belonging to periods 4 to 7 of groups 3 to 16 in the periodic table and compounds containing any of such metals, in the presence or absence of a solvent, the fluorine-containing disulfonyl chloride represented by general formula (2):



This method, which uses a fluorine-containing disulfonyl chloride as the starting material, utilizes the same reaction as that of Claim 6 in that the material to be reacted with the starting material is “at least one member selected from the group consisting of metals belonging to periods 4 to 7 of groups 3 to 16 in the periodic table and compounds containing any of such metals,” and the



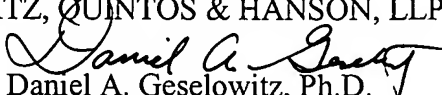
product is a fluorine-containing chloride wherein the chlorine atoms are directly attached to the carbon atoms.

On the other hand, as described in items (i) and (ii) above in connection with Claims 1 and 6, Drivon et al. merely disclose HBr and a quaternary (ammonium or phosphonium) bromide as a material to be reacted with a sulfonyl chloride. Similarly, Storzer et al. merely discloses a method for reacting a sulfonyl fluoride with KF, which is an alkali metal fluoride.

Accordingly, claims 11 and 16, as well as dependent claims 12-15 and 17-20, are also not obvious over the Drivon et al. references and Storzer et al., taken separately or in combination.

If, for any reason, it is felt that this application is not now in condition for allowance, the Examiner is requested to contact the applicants' undersigned agent at the telephone number indicated below to arrange for an interview to expedite the disposition of this case.

In the event that this paper is not timely filed, the applicants respectfully petition for an appropriate extension of time. Please charge any fees for such an extension of time and any other fees which may be due with respect to this paper, to Deposit Account No. 01-2340.

Respectfully submitted,  
KRATZ, QUINTOS & HANSON, LLP  
  
Daniel A. Geselowitz, Ph.D.  
Agent for Applicants  
Reg. No. 42,573

DAG/xl

Atty. Docket No. 060706  
Suite 400  
1420 K Street, N.W.  
Washington, D.C. 20005  
(202) 659-2930



23850

PATENT & TRADEMARK OFFICE

Enclosure: Declaration under 37 CFR 1.132 signed by Mr. Akinari SUGIYAMA